

3-31-15

64889 - R8 CAA



**US EPA
Source Test Report**

**XTO Energy, Inc.
Little Canyon Facility,
Utah**

March 4, 2015

Permit: N/A

Engine: Caterpillar G3516LE

SN: 4EK04246

Unit ID: LCU #2

Prepared By:

Oasis Emission Consultants, Inc.
2730 Commercial Way
Rock Springs, WY 82901





March 31, 2015

Mr. Craig Allison
XTO Energy, Inc.
810 Houston Street
Fort Worth, TX 76102

Dear Mr. Allison:

Re: Engine Emission Testing For XTO Energy, Inc., Little Canyon Facility Unit LCU #2.

Oasis Emission Consultants, Inc. was requested to perform an engine emission test on a Caterpillar G3516LE lean burn engine located on tribal land in Utah.

Emission Levels

The average recorded levels are shown in the attached report, and summarized below.

Emission Unit	Avg NOx	Avg CO
g/BHP-hr	0.25	0.16
lbs/hr	0.40	0.27

Formaldehyde Levels

Test Run	HCOH (ppm)	HCOH @ 15% O2 (ppm)	HCOH @ 15 % O2 Limit
1	12.49	6.58	14
2	14.85	7.82	14
3	13.74	7.24	14
AVG	13.69	7.21	14

Catalyst Parameters

Test Run	Inlet Temp (°F)	DP (in H ₂ O)
1	802	4.0
2	802	4.0
3	804	4.0
AVG	803	4.0

Engine Load

Test Run	BHP
1	1263.2
2	1260.9
3	1262.2

Testing Protocol

The attached report was generated using an extractive FTIR system using methodologies as required by EPA 40 CFR 60 Methods 1, 19, ASTM D6522-00(2005) and ASTM D6348 – 03 and/or EPA 40 CFR 63(A) Method 320.

Quality Assurance

Oasis has performed a full cursory review of the raw data and calculated results in this report. Any errors we have encountered have been listed in the body of this report. After performing the review, we are confident that this engine has met all requirements.

If you have any questions or require further information, please contact the undersigned at (307) 382-3297.

Yours truly,
Oasis Emission Consultants, Inc.



Charles A. Chapman
Senior Environmental Scientist



Christopher N. Knott, P.Eng.
Director, Engineering & Operations

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SOURCE EMISSION TEST REPORT

PERMIT N/A

Test Performed By: **Oasis Emission Consultants, Inc.**

Facility Name: **Little Canyon Facility
Unit LCU #2**

Emission Source: **Caterpillar G3516LE**

Date of Test: **March 4, 2015**

Date of Report: **March 31, 2015**

1.1 Introduction

The purpose of this source test was to demonstrate that source emissions from a Caterpillar G3516LE engine do not exceed maximum allowable levels specified by guidelines issued in EPA 40 CFR 63, Subpart ZZZZ.

The Caterpillar G3516LE engine is a lean burn engine that employs an Oxidation Catalytic Converter to regulate emission levels.

Three test runs were performed on March 4, 2015 to analyze NOx, CO & HCOH emission levels according to methodologies outlined in the ASTM D 6348-03 & EPA 40 CFR 63(A), Method 320 Protocol. Effluent exhaust was sampled from the engine through an extractive heated stainless steel sample line interconnected to an MKS 2030 FTIR analyzer.

Each of the three runs consisted of sixty (60) readings taken at one (1) minute intervals.

Test runs were observed by the following individuals:

- Stephen Pyer, Oasis Emission Consultants, Inc.
- Derrick, XTO Energy, Inc.

2.1 Equipment Utilization

The following equipment was used during the tests performed at this facility in conjunction with procedures outlined by ASTM D 6348-03 & EPA 40 CFR 63(A), Method 320.

- (1) MKS MultiGas 2030 FTIR Continuous Gas Analyzer
- (1) Laptop Computer For The FTIR Analyzer Using MKS MG2000 Software
- (1) 30ft or 100ft Heated Teflon Line w/ Heated Sample Probe & Spike Bypass Line
- (1) Portable O₂/CO₂ Analyzer
- (6) EPA Protocol G1 Calibration Gas (CO, NO_x, C₂H₄, CH₃CHO, C₃H₈ & NO₂)

The MKS Multigas 2030 FTIR Analyzer was used to measure NO_x & CO on a dry basis. Formaldehyde levels were measured on a wet basis and were corrected to produce levels on a dry basis. A pre Direct and System calibration measurement was made on compounds of NO_x, CO, CH₃CHO, C₃H₈ & C₂H₄. In addition, a post Direct calibration was made on compounds of NO_x, CO, CH₃CHO & C₃H₈. A post System calibration was also conducted for C₂H₄. Compounds of CO₂, CO, NO, CH₃CHO & C₃H₈ were measured for the quality assurance spiking requirements of ASTM D 6348-03 & EPA 40 CFR 63(A), Method 320

When a gas sample is introduced in the gas cell, the infrared beam is partially absorbed by the gas species present. The spectral frequencies absorbed and their intensity are due to the atoms associated with the chemical bond and the strength of that bond. The absorption spectrum is unique for each infrared-active gas. The MKS Analyzer measures the absorption spectrum, and its analysis algorithm measures the concentration of each gas using pre-loaded calibrations. The MG2000 software allows for the continuous measurement, display and recording of the sample stream.

The MKS Multigas 2030 FTIR Analyzer operated with a spectral resolution of 0.5 cm⁻¹ and a scan time of 30 seconds. The FTIR spectrometer utilizes a multi-pass gas cell with a 5.11 meter effective pathlength.

3.1 Discussion Of NOx, CO & HCOH Test Results

Please refer to Appendix A for the raw NOx, CO & HCOH test results. Please refer to Appendix B for a listing of all raw data, calibration error response and calculations performed per ASTM & EPA requirements. Overall the average emission levels complied with Consent Decree guidelines on a g/BHP-hr basis. Testing for NOx, CO & HCOH were run concurrently with one another.

3.1.1 Source Test 1: Caterpillar G3516LE, NOx, CO & HCOH

The first test was performed from 13:14 to 14:16 for NOx, CO & HCOH.

The average NOx and CO levels were found to be **0.23 g/BHP-hr and 0.16 g/BHP-hr** respectively. The Formaldehyde level was found to be **6.58 ppm @ 15% O₂**, which tested in compliance with the current EPA standards.

Test Run	NOx (ppm)	NOx (g/BHP-hr)	CO (ppm)	CO (g/BHP-hr)	HCOH (ppm)	HCOH @ 15% O ₂ (ppm)
1	27.67	0.23	30.88	0.16	12.49	6.58

3.1.2 Source Test 2: Caterpillar G3516LE, NOx, CO & HCOH

The second test was performed from 14:21 to 15:23 for NOx, CO & HCOH.

The average NOx and CO levels were found to be **0.27 g/BHP-hr and 0.17 g/BHP-hr** respectively. The Formaldehyde level was found to be **7.82 ppm @ 15% O₂**, which tested in compliance with the current EPA standards.

Test Run	NOx (ppm)	NOx (g/BHP-hr)	CO (ppm)	CO (g/BHP-hr)	HCOH (ppm)	HCOH @ 15% O ₂ (ppm)
2	33.08	0.27	34.50	0.17	14.85	7.82

3.1.3 Source Test 3: Caterpillar G3516LE, NOx, CO & HCOH

The third test was performed from 15:27 to 16:30 for NOx, CO & HCOH.

The average NOx and CO levels were found to be **0.25 g/BHP-hr and 0.16 g/BHP-hr** respectively. The Formaldehyde level was found to be **7.24 ppm @ 15% O₂**, which tested in compliance with the current EPA standards.

Test Run	NOx (ppm)	NOx (g/BHP-hr)	CO (ppm)	CO (g/BHP-hr)	HCOH (ppm)	HCOH @ 15% O ₂ (ppm)
3	29.86	0.25	32.56	0.16	13.74	7.24

4.1 Stack Sampling Location

The sampling port for moisture, flow, NOx, CO and HCOH measurements was approximately 4 pipe diameters from the nearest upstream flow disturbance and 4 pipe diameters from the nearest downstream disturbance.

4.2 Stack Sampling Methods & Procedures

Testing followed EPA 40 CFR 63(A), Method 320 and/or ASTM D6348-03 methodologies per our standard protocol, with no exceptions.

5.1 Quality Assurance

CTS procedures were followed according to ASTM requirements for both pre and post testing. Similarly, QA spiking procedures were followed. Analysis of the CO₂ exhaust effluent was used to determine the dilution factor. Steady levels of the CO₂ were observed and a sufficient duration of time was allowed to elapse for a representative average.

The calibration gas was spiked into the effluent stream using a bypass line at approximately 10% of the sampling rate. The dilution factor was obtained from observation of the stack CO₂ behavior using the following equation:

$$DF = \frac{CO_2\text{AVG} - CO_2\text{SPIKE}}{CO_2\text{AVG}}$$

Where: CO₂AVG = The average undiluted CO₂ stack gas concentration of spike measurements
CO₂SPIKE = The average diluted CO₂ stack gas concentration when spiked

The sample recovery was then obtained from the following equation:

$$\frac{\% \text{ REC} = (Spike \text{ MEAS} - Stack \text{ MEAS}) * (1 - DF)}{CS * DF}$$

Where: Spike MEAS = The average diluted stack gas concentration when spiked
Stack MEAS = The average undiluted stack gas concentration
DF = Dilution factor
CS = Certified concentration of calibration standards

The Sample Recovery average level for CO, NO, C₃H₈ & CH₃CHO was found to be 92.1%, 88.9%, 91.4% & 73.7% respectively, which was within the allowable tolerance of Method 320 (70% to 130%). A summary of all spiking procedures/results can be found in Appendix B.

APPENDIX A

XTO Energy, Inc.

LCU #2

Run 1

Record	FTIR Measurements				Date	Time
	NOx Dry	CO ppm Dry	Formaldehyde 191C Wet	H2O% (High) 191C		
1	21.483589	26.974754	9.792497	10.340089	3/4/2015	13:14:20
2	21.595091	26.584521	9.214271	10.866335	3/4/2015	13:15:23
3	21.034397	26.075222	9.449218	11.916458	3/4/2015	13:16:27
4	21.285807	26.322245	9.496374	11.198852	3/4/2015	13:17:30
5	22.429387	26.953551	9.630664	11.57084	3/4/2015	13:18:33
6	22.459229	26.534949	9.01164	11.384668	3/4/2015	13:19:36
7	21.59442	26.964761	8.714157	10.402215	3/4/2015	13:20:39
8	22.477991	26.721761	8.867688	10.504524	3/4/2015	13:21:43
9	21.009835	26.338093	9.387317	11.711979	3/4/2015	13:22:46
10	22.008164	26.298894	9.158712	11.053386	3/4/2015	13:23:49
11	21.630071	25.94383	9.257446	11.399978	3/4/2015	13:24:52
12	21.436578	25.73531	9.482719	11.51734	3/4/2015	13:25:56
13	21.650292	26.216121	9.859115	11.243378	3/4/2015	13:26:59
14	21.559912	26.070078	8.433779	10.203758	3/4/2015	13:28:02
15	21.36107	26.579981	9.03944	11.090486	3/4/2015	13:29:05
16	22.319809	26.797287	8.751407	10.854434	3/4/2015	13:30:08
17	21.691054	26.554598	8.512289	10.500348	3/4/2015	13:31:12
18	22.353542	26.649967	8.027187	10.028121	3/4/2015	13:32:15
19	22.294759	26.535271	7.867599	9.120558	3/4/2015	13:33:18
20	22.813582	25.974888	8.975382	11.472085	3/4/2015	13:34:21
21	21.978312	26.508566	9.12664	11.211278	3/4/2015	13:35:24
22	21.960828	26.706445	9.249803	10.868378	3/4/2015	13:36:28
23	22.035323	26.561429	9.670656	12.211501	3/4/2015	13:37:31
24	22.497375	26.022872	9.162401	11.129915	3/4/2015	13:38:34
25	22.536768	26.690497	8.871639	10.343587	3/4/2015	13:39:37
26	22.570133	26.298644	9.253218	11.560927	3/4/2015	13:40:41
27	25.523552	28.595559	9.545973	11.551256	3/4/2015	13:41:44
28	33.148239	33.037413	10.015691	9.976016	3/4/2015	13:42:47
29	32.44188	34.054655	10.538523	9.922156	3/4/2015	13:43:50
30	33.293342	33.70417	11.913454	11.141556	3/4/2015	13:44:53
31	31.679522	34.447828	11.36521	10.49856	3/4/2015	13:45:57
32	31.81488	34.287525	12.140469	10.674988	3/4/2015	13:47:00
33	33.273272	34.23302	12.117804	11.126529	3/4/2015	13:48:03
34	31.454405	34.239087	11.311943	10.17043	3/4/2015	13:49:06
35	31.973248	34.432058	12.862755	10.092528	3/4/2015	13:50:10
36	32.03059	34.490656	14.715098	13.376381	3/4/2015	13:51:13
37	31.856391	34.274577	15.055419	12.369037	3/4/2015	13:52:16
38	31.142895	34.491093	13.931154	11.096864	3/4/2015	13:53:19
39	31.767973	34.230949	12.830825	10.96387	3/4/2015	13:54:22
40	32.72888	34.07099	11.760746	10.021032	3/4/2015	13:55:26
41	32.673704	34.122296	11.657149	10.201572	3/4/2015	13:56:29
42	30.854254	34.507312	13.947224	12.176949	3/4/2015	13:57:32
43	31.775598	34.543392	13.229783	11.221027	3/4/2015	13:58:35
44	31.172763	34.627194	12.574284	10.214548	3/4/2015	13:59:39
45	31.475979	34.534683	13.817772	10.736467	3/4/2015	14:00:42
46	33.189689	34.411047	12.796402	10.579666	3/4/2015	14:01:45
47	33.123305	34.648285	12.838921	9.960268	3/4/2015	14:02:48
48	33.683997	34.84512	13.622872	11.729309	3/4/2015	14:03:51
49	32.889858	34.598654	12.535263	10.754498	3/4/2015	14:04:55
50	33.741551	35.115738	12.349366	10.222463	3/4/2015	14:05:58
51	31.427051	35.661861	14.194639	11.319029	3/4/2015	14:07:01
52	32.815613	34.172192	13.097377	10.447837	3/4/2015	14:08:04
53	31.760945	34.301958	13.317707	10.585699	3/4/2015	14:09:08
54	31.85281	34.5198	13.389117	11.413181	3/4/2015	14:10:11
55	32.342398	34.005557	12.511048	10.799102	3/4/2015	14:11:14
56	32.365701	34.442093	13.371547	10.93915	3/4/2015	14:12:17
57	31.776863	34.785585	14.240943	11.266145	3/4/2015	14:13:20
58	32.935603	34.88198	13.343306	10.615748	3/4/2015	14:14:24
59	32.069981	34.75875	13.014796	10.028132	3/4/2015	14:15:27
60	31.894737	34.871648	11.370494	9.53631	3/4/2015	14:16:30
AVG	27.67	30.88	11.13	10.89		

Calculated Emission Levels					
NOx (g/BHP-hr)	NOx (lbs/hr)	CO (g/BHP-hr)	CO (lbs/hr)	HCOH Dry (ppm)	HCOH @ 15% O2 (ppm)
0.23	0.64	0.16	0.43	12.49	6.58

XTO Energy, Inc.

LCU #2

Run 2

Record	FTIR Measurements				Date	Time
	NOx Dry	CO ppm Dry	Formaldehyde 191C Wet	H2O% (High) 191C		
1	31.138947	35.170641	11.786776	6.923578	3/4/2015	14:21:05
2	31.356772	34.671435	12.031113	7.815926	3/4/2015	14:22:08
3	32.536566	34.213247	13.329966	9.672501	3/4/2015	14:23:11
4	31.976104	34.751013	13.702105	10.855026	3/4/2015	14:24:14
5	32.063382	34.362109	13.058343	10.451235	3/4/2015	14:25:18
6	31.998879	34.700769	12.385737	10.123008	3/4/2015	14:26:21
7	33.088963	34.618529	15.057877	11.945276	3/4/2015	14:27:24
8	32.671451	34.430434	14.756317	12.06376	3/4/2015	14:28:27
9	32.796281	34.479643	14.24042	11.562115	3/4/2015	14:29:30
10	32.459442	34.537016	13.470205	10.418872	3/4/2015	14:30:34
11	33.261613	34.988958	11.587811	9.471554	3/4/2015	14:31:37
12	32.037967	34.909512	11.512347	9.71404	3/4/2015	14:32:40
13	31.585794	34.763885	12.782462	10.578643	3/4/2015	14:33:43
14	31.031699	34.641178	14.69598	12.278657	3/4/2015	14:34:47
15	31.446517	35.285066	14.162412	11.79252	3/4/2015	14:35:50
16	31.023061	35.049324	14.313203	11.416861	3/4/2015	14:36:53
17	33.064268	34.844855	14.063811	10.822744	3/4/2015	14:37:56
18	33.351954	34.879593	12.646256	10.367979	3/4/2015	14:38:59
19	32.462413	35.420493	13.138421	10.892183	3/4/2015	14:40:03
20	32.937695	34.679658	12.807446	10.259997	3/4/2015	14:41:06
21	34.113765	34.64151	13.843112	11.174822	3/4/2015	14:42:09
22	34.317455	34.157576	12.269969	10.223294	3/4/2015	14:43:12
23	33.681637	34.900809	13.048313	11.097191	3/4/2015	14:44:16
24	33.490025	34.674835	13.854337	11.457356	3/4/2015	14:45:19
25	34.288661	34.378083	12.784184	10.132499	3/4/2015	14:46:22
26	33.348889	34.872423	14.203038	11.483703	3/4/2015	14:47:25
27	33.421721	34.498087	13.555555	10.803651	3/4/2015	14:48:28
28	33.393893	34.81882	14.19747	11.655615	3/4/2015	14:49:32
29	32.24078	34.951569	13.437816	10.949644	3/4/2015	14:50:35
30	33.257613	35.142871	13.373926	10.39996	3/4/2015	14:51:38
31	32.608029	35.452957	13.122715	10.082288	3/4/2015	14:52:41
32	34.370929	35.714604	11.804349	9.456329	3/4/2015	14:53:45
33	34.165476	34.783244	14.200061	11.785907	3/4/2015	14:54:48
34	34.343078	35.978184	14.497419	11.979562	3/4/2015	14:55:51
35	34.030095	35.748342	12.93269	10.652809	3/4/2015	14:56:54
36	32.778661	34.993527	12.663806	10.477258	3/4/2015	14:57:57
37	32.725733	34.877952	13.797564	10.892729	3/4/2015	14:59:01
38	32.662273	34.428962	14.758295	12.399955	3/4/2015	15:00:04
39	33.734956	34.59499	14.14049	10.8278	3/4/2015	15:01:07
40	33.430397	35.017283	14.150714	11.296257	3/4/2015	15:02:10
41	35.034942	34.682597	13.035009	10.812121	3/4/2015	15:03:14
42	35.865905	34.745714	11.747711	10.025545	3/4/2015	15:04:17
43	35.643284	34.67071	13.59963	11.865039	3/4/2015	15:05:20
44	34.10119	34.540081	11.767527	9.906251	3/4/2015	15:06:23
45	33.846923	34.651441	13.65335	11.461914	3/4/2015	15:07:26
46	33.038051	34.535082	12.940005	10.645972	3/4/2015	15:08:30
47	35.048623	35.126688	12.32605	10.004746	3/4/2015	15:09:33
48	36.20364	35.722879	13.643675	11.136501	3/4/2015	15:10:36
49	35.401405	35.878907	12.175011	9.760866	3/4/2015	15:11:39
50	34.071124	35.769365	13.845227	11.133174	3/4/2015	15:12:42
51	34.148329	35.996915	14.531666	11.615044	3/4/2015	15:13:46
52	34.128407	35.931358	14.410839	11.707162	3/4/2015	15:14:49
53	33.966961	35.600154	14.371894	11.554913	3/4/2015	15:15:52
54	34.254177	35.357538	13.988883	10.855816	3/4/2015	15:16:55
55	34.567161	35.707399	14.897713	11.131112	3/4/2015	15:17:58
56	35.823421	35.268751	13.506168	10.608732	3/4/2015	15:19:02
57	31.215937	31.519366	12.648359	11.068916	3/4/2015	15:20:05
58	28.669666	26.624877	10.949679	11.253241	3/4/2015	15:21:08
59	27.008524	26.758332	9.856579	10.562246	3/4/2015	15:22:11
60	27.90727	27.127431	10.643029	11.812759	3/4/2015	15:23:14
AVG	33.08	34.50	13.25	10.79		

Calculated Emission Levels

NOx (g/BHP-hr)	NOx (lbs/hr)	CO (g/BHP-hr)	CO (lbs/hr)	HCOH Dry (ppm)	HCOH @ 15% O2 (ppm)
0.27	0.76	0.17	0.48	14.85	7.82

XTO Energy, Inc.

LCU #2

Run 3

Record	FTIR Measurements				Date	Time
	NOx Dry	CO ppm Dry	Formaldehyde 191C Wet	H2O% (High) 191C		
1	23.642174	27.064593	8.47726	7.473325	3/4/2015	15:27:51
2	24.77494	26.549497	8.410621	8.278943	3/4/2015	15:28:54
3	24.170693	26.526532	8.471268	9.820327	3/4/2015	15:29:57
4	22.937019	26.586838	9.287301	10.681679	3/4/2015	15:31:00
5	22.918222	26.478171	9.255988	10.833148	3/4/2015	15:32:03
6	22.726571	26.370711	9.258923	11.069863	3/4/2015	15:33:07
7	23.31356	26.140346	10.696521	11.986656	3/4/2015	15:34:10
8	23.149948	26.293218	10.357192	12.346089	3/4/2015	15:35:13
9	22.442408	26.738088	9.290234	10.49315	3/4/2015	15:36:16
10	23.337062	26.456498	8.958039	10.956748	3/4/2015	15:37:19
11	24.013497	26.458916	9.961559	11.719464	3/4/2015	15:38:23
12	23.055918	26.41977	10.194449	11.752658	3/4/2015	15:39:26
13	22.198481	26.730105	9.568705	11.323393	3/4/2015	15:40:29
14	22.206935	26.655943	9.102818	11.302761	3/4/2015	15:41:32
15	22.004548	27.512816	9.026645	10.618907	3/4/2015	15:42:35
16	24.295815	27.706591	9.754776	11.49859	3/4/2015	15:43:39
17	30.399005	31.710846	10.302957	10.659112	3/4/2015	15:44:42
18	33.300327	33.474557	10.961003	10.199111	3/4/2015	15:45:45
19	33.737104	33.575992	12.227818	11.443504	3/4/2015	15:46:48
20	33.032755	33.884427	11.089431	9.891241	3/4/2015	15:47:51
21	32.198012	34.517477	14.311916	11.909059	3/4/2015	15:48:55
22	32.769122	34.543131	14.184201	11.99888	3/4/2015	15:49:58
23	32.654841	34.068805	12.859471	10.295885	3/4/2015	15:51:01
24	32.104761	34.342996	11.389877	9.731242	3/4/2015	15:52:04
25	32.53993	34.531052	12.514654	10.832005	3/4/2015	15:53:07
26	33.083365	34.196615	13.212231	11.312445	3/4/2015	15:54:11
27	32.557686	34.617758	15.549963	12.522596	3/4/2015	15:55:14
28	32.003454	35.578635	14.68027	11.810259	3/4/2015	15:56:17
29	31.875944	35.190986	12.616452	10.085352	3/4/2015	15:57:20
30	32.214824	35.15769	11.849402	9.996217	3/4/2015	15:58:24
31	32.702128	34.598275	13.812324	11.428774	3/4/2015	15:59:27
32	32.456291	35.209953	13.610844	11.216833	3/4/2015	16:00:30
33	32.911177	35.08378	12.732546	10.557909	3/4/2015	16:01:33
34	32.749361	35.348551	11.92405	9.848444	3/4/2015	16:02:36
35	32.226676	35.029016	13.706538	11.361997	3/4/2015	16:03:40
36	32.218371	34.735973	15.50405	12.811963	3/4/2015	16:04:43
37	31.765827	34.917207	14.540205	11.182891	3/4/2015	16:05:46
38	32.506149	34.957256	14.43964	11.829907	3/4/2015	16:06:49
39	32.596147	35.097978	13.745105	11.20205	3/4/2015	16:07:52
40	31.479504	35.055658	13.504315	11.031082	3/4/2015	16:08:56
41	33.202046	35.388905	12.798731	9.817365	3/4/2015	16:09:59
42	33.918704	34.374502	12.340419	9.530412	3/4/2015	16:11:02
43	34.396944	34.160274	11.798434	9.859153	3/4/2015	16:12:05
44	33.707017	34.221523	13.45041	11.291673	3/4/2015	16:13:08
45	33.030515	34.198721	14.850121	12.589046	3/4/2015	16:14:12
46	32.955331	34.701864	12.704656	10.407413	3/4/2015	16:15:15
47	33.316284	34.71688	11.667788	9.20976	3/4/2015	16:16:18
48	32.407146	34.318157	12.99631	10.453994	3/4/2015	16:17:21
49	32.332115	34.379744	14.83675	12.583499	3/4/2015	16:18:24
50	32.177674	35.100294	14.134572	11.593391	3/4/2015	16:19:28
51	31.598472	35.326098	14.314174	11.441247	3/4/2015	16:20:31
52	30.949029	35.032977	14.163999	10.517002	3/4/2015	16:21:34
53	31.480567	35.422791	13.120192	10.11941	3/4/2015	16:22:37
54	31.290666	35.041002	14.089694	11.64838	3/4/2015	16:23:40
55	30.740379	35.123625	14.209489	11.53859	3/4/2015	16:24:44
56	31.054098	35.375018	13.543236	11.097529	3/4/2015	16:25:47
57	31.383613	34.777832	13.784506	11.283695	3/4/2015	16:26:50
58	31.156793	34.946096	14.102603	10.883479	3/4/2015	16:27:53
59	31.12959	35.493518	14.081127	10.524691	3/4/2015	16:28:56
60	30.294646	35.360336	12.258408	9.819823	3/4/2015	16:30:00
AVG	29.86	32.56	12.24	10.89		

Calculated Emission Levels

NOx (g/BHP-hr)	NOx (lbs/hr)	CO (g/BHP-hr)	CO (lbs/hr)	HCOH Dry (ppm)	HCOH @ 15% O2 (ppm)
0.25	0.69	0.16	0.46	13.74	7.24

APPENDIX B

Raw Calibration Data

BACKGROUND

Date	Time	NO 191C span	NO2 191C span	H2O% (high) 191C	Formaldehyde 191C	Ethylene 191C TE span	Propene 191C span	Acetdehyde 191C span	CO ppm 191C (10x) span	CO ppm 191C (10x) Drv	CO2% 191C	NOx Wet	NOx Dry	NM HC C3
3/4/2015	12:54:08	0.003217	0.033749	-0.033749	0.043102	0.309515	0.301531	0.178405	0.009919	0.009944	0.012116	-0.000330	0.000546	0.000544
3/4/2015	12:54:15	0.161479	-0.130747	0.037665	0.454915	0.020976	1.250818	0.488309	0.291118	0.291217	0.002978	0.037333	0.037444	1.337010
3/4/2015	12:55:23	-0.012532	0.035398	0.027378	0.320984	-0.013352	0.944479	0.181767	0.143652	0.143651	-0.009134	0.041058	0.041069	0.700343
3/4/2015	12:55:29	0	0	0	0	0	0	0	0	0	0	0	0	0
3/4/2015	12:55:16	0.039621	0.026956	-0.025242	-0.21478	-0.165127	1.318103	0.123184	-0.060028	-0.060079	-0.015974	0.009553	0.009553	1.091415
3/4/2015	12:55:24	0.039621	0.026956	-0.025242	-0.21478	-0.165127	1.318103	0.123184	-0.060028	-0.060079	-0.015974	0.009553	0.009553	1.091415
3/4/2015	12:55:31	0.165564	-0.094244	0.024102	0.214811	-0.141141	0.243397	0.123209	0.118311	0.118309	0.014877	-0.029364	-0.029364	0.535712
3/4/2015	12:55:39	-0.000129	-0.097444	-0.008434	-0.060143	-0.41878	0.889253	0.48779	0.094605	0.094597	-0.019864	-0.211787	-0.211787	0.000300
3/4/2015	12:55:47	0.219306	-0.135424	-0.014336	-0.069333	-0.319569	0.403178	0.144698	0.085347	0.085338	-0.011365	0.083882	0.083882	0.230299
3/4/2015	12:56:03	0.020093	0.021119	-0.011798	-0.178902	-0.762770	0.307000	0.134794	0.134794	0.134794	-0.134794	-0.307174	-0.307174	0.505647
3/4/2015	12:56:03	-0.408114	-0.014897	-0.007195	-0.356493	-1.292449	0.370911	-0.207475	0.205677	0.205677	0.016183	-0.437722	-0.437722	0.000398
3/4/2015	12:56:11	0.074460	0.018144	0.009969	-0.200118	0.897142	1.534863	0.084093	-0.384558	-0.384558	-0.009527	0.090837	0.090837	1.439129
3/4/2015	12:56:19	0.000089	0.024881	-0.006995	-0.198461	-0.44871	0.198281	0.598157	-0.103559	-0.103559	0.007785	-0.039849	-0.039849	0.004825
3/4/2015	12:56:27	-0.091988	0.007943	-0.009479	0.146715	-0.106932	0.969728	0.418447	-0.039942	-0.039942	-0.008754	-0.107123	-0.107123	0.298076

PRE DIRECT CAL

Date	Time	CO ppm 191C (10x) span	NOx Wet	Propane 191C span	Date	Time	Ethylene 191C TE	Date	Time	Acetdehyde 191C span
3/4/2015	12:56:35	134.804351	147.185674	125.249861	3/4/2015	13:00:36	18.081120	3/4/2015	12:58:03	9.807362
3/4/2015	12:56:43	487.827555	474.862054	496.949549	3/4/2015	12:00:44	90.869062	3/4/2015	12:58:10	30.335371
3/4/2015	12:56:51	496.730203	503.747495	498.730207	3/4/2015	12:00:52	100.84723	3/4/2015	12:58:17	32.300562
3/4/2015	12:56:58	498.644106	503.650493	498.730279	3/4/2015	12:00:59	101.83203	3/4/2015	12:58:25	32.882029
3/4/2015	12:57:06	497.286027	505.269918	497.052154	3/4/2015	13:01:07	101.095183	3/4/2015	12:58:33	33.372771
3/4/2015	12:57:14	497.177122	505.152213	497.177113	3/4/2015	13:01:15	101.249653	3/4/2015	12:58:41	32.785585
3/4/2015	12:57:22	497.434585	504.748712	500.595209	3/4/2015	13:01:23	94.460803	3/4/2015	12:58:49	32.786932
3/4/2015	12:57:30	497.759495	505.936467	499.174813	3/4/2015	13:01:31	100.86747	3/4/2015	12:58:57	33.39991
3/4/2015	12:57:38	497.417177	505.362046	500.380292	3/4/2015	13:01:39	100.715027	3/4/2015	13:01:47	100.935511
					3/4/2015	13:01:47	101.095183	3/4/2015	13:01:55	100.934979

NO2 CAL

Date	Time	NO 191C span	35.0802017
3/4/2015	12:58:19	142.618726	
3/4/2015	12:58:26	151.889885	
3/4/2015	12:58:43	151.642238	
3/4/2015	12:59:51	152.495548	
3/4/2015	12:59:59	152.799700	
3/4/2015	13:00:07	153.37879	
3/4/2015	13:00:15	153.439834	

PRE SYSTEM CAL

Date	Time	CO ppm 191C (10x) span	NOx Wet	Propane 191C span	Date	Time	Ethylene 191C TE	Date	Time	Acetdehyde 191C span
3/4/2015	13:02:16	24.750238	24.751428	26.045089	3/4/2015	13:00:11	7.950569	3/4/2015	13:04:41	0.133302
3/4/2015	13:02:23	303.860316	311.549189	294.059619	3/4/2015	13:00:18	15.861541	3/4/2015	13:05:51	0.392755
3/4/2015	13:02:31	492.332086	499.405247	499.405247	3/4/2015	13:00:25	86.444029	3/4/2015	13:05:58	0.391988
3/4/2015	13:02:39	471.539867	477.059354	480.265367	3/4/2015	13:00:35	101.901848	3/4/2015	13:04:07	31.506195
3/4/2015	13:02:47	481.8811	487.557783	487.08431	3/4/2015	13:00:43	102.163328	3/4/2015	13:04:15	35.418559
3/4/2015	13:02:55	492.534235	497.059354	500.265367	3/4/2015	13:00:51	102.897605	3/4/2015	13:04:23	35.333779
3/4/2015	13:03:03	497.626469	503.265464	498.588378	3/4/2015	13:00:59	102.887607	3/4/2015	13:04:30	34.0509
3/4/2015	13:03:11	498.409317	505.395127	501.371375	3/4/2015	13:00:07	102.216455	3/4/2015	13:04:38	33.581998
3/4/2015	13:03:19	498.124293	504.969423	502.341997	3/4/2015	13:00:23	101.729820	3/4/2015	13:04:46	34.320229
					3/4/2015	13:00:30	100.977146			

SAMPLE SPIKE RECOVERY

Date	Time	CO2% 191C	CO ppm 191C (10f2) span	NO 191C span	Propane 191C span
3/4/2015	13:10:23	6.123014	24.075141	16.376778	24.102668
3/4/2015	13:10:23	6.123014	24.075141	18.443204	24.232698
3/4/2015	13:10:38	6.150601	25.02742	17.956608	25.470127
3/4/2015	13:10:48	6.151198	24.024421	18.055353	22.700169
3/4/2015	13:10:54	6.151198	24.024421	18.959912	22.800185
3/4/2015	13:11:10	5.989322	24.383033	19.393999	24.263549
3/4/2015	13:11:18	5.185264	24.089461	18.803449	23.846074
3/4/2015	13:11:28	5.185264	24.089461	18.959998	23.712671
3/4/2015	13:11:34	2.797848	10.988115	9.249498	11.327989
3/4/2015	13:11:42	2.805975	12.470987	11.310621	13.362151
3/4/2015	13:11:50	5.454944	13.013988	48.370509	59.313114
3/4/2015	13:11:57	5.454944	73.009535	66.202023	71.303204
3/4/2015	13:12:05	5.454974	72.77741	66.356496	73.010331
3/4/2015	13:12:13	5.454974	7.871697	65.102471	71.311361
3/4/2015	13:12:21	5.242333	75.447285	64.723248	69.823231
3/4/2015	13:12:29	5.309585	87.658744	61.125225	66.434985
3/4/2015	13:12:37	5.309585	87.704117	60.267025	65.544585
3/4/2015	13:12:53	5.457815	54.552771	54.159214	55.822271
3/4/2015	13:13:01	5.479429	64.231103	57.069099	62.2273

ACETALDEHYDE SPIKE RECOVERY

Date	Time	CO2% 191C	Acetaldehyde 191C span
3/4/2015	13:06:57	6.193433	0.239485
3/4/2015	13:07:04	6.311561	0.379575
3/4/2015	13:07:12	6.311561	0.379575
3/4/2015	13:07:20	6.337849	0.291988
3/4/2015	13:07:28	6.331244	0.10553
3/4/2015	13:07:36	6.331244	0.233333
3/4/2015	13:07:44	5.493913	0.003054
3/4/2015	13:07:52	6.307515	0.348546
3/4/2015	13:07:59	6.307515	0.448544
3/4/2015	13:08:09	2.162094	0.389087
3/4/2015	13:08:16	1.070644	0.655773
3/4/2015	13:08:24	1.070644	0.612688
3/4/2015	13:08:31	3.125693	14.893021
3/4/2015	13:08:39	5.329569	5.531154
3/4/2015	13:08:47	6.304962	3.771708
3/4/2015	13:08:55	6.304962	3.882081
3/4/2015	13:09:03	5.431881	2.069857
3/4/2015	13:09:11	5.431881	3.226617
3/4/2015	13:09:19	5.445913	2.126491
3/4/2015	13:09:27	5.589952	3.405957
3/4/2015	13:09:35	5.803381	2.005972
3/4/2015	13:09:43	5.811291	1.834989
3/4/2015	13:09:50	5.951226	2.57311
3/4/2015	13:09:58	5.922304	2.127938

POST DIRECT CAL

Date	Time	CO ppm 191C (10f2) span	NOx Wet	Propane 191C span	Date	Time	Acetaldehyde 191C span
3/4/2015	18:34:42	-0.000458	0.100994	-0.474691	3/4/2015	18:36:37	7.475797
3/4/2015	18:34:49	-0.000458	0.111191	-0.500203	3/4/2015	18:36:45	30.200527
3/4/2015	18:34:57	-0.402688	-0.141130	-1.457977	3/4/2015	18:36:53	31.540171
3/4/2015	18:35:05	-0.000442	-0.087298	-0.514288	3/4/2015	18:37:01	32.842359
3/4/2015	18:35:13	198.000000	212.11775	179.240009	3/4/2015	18:37:09	32.846039
3/4/2015	18:35:21	487.324493	491.292013	483.202074	3/4/2015	18:37:17	32.846151
3/4/2015	18:35:29	497.000008	502.255174	494.486037	3/4/2015	18:37:24	32.759259
3/4/2015	18:35:37	496.412005	503.178042	498.024308	3/4/2015	18:37:32	32.156749
3/4/2015	18:35:45	496.412005	503.178042	498.024308	3/4/2015	18:37:40	32.446321
3/4/2015	18:35:53	495.754451	502.018102	497.399998			
3/4/2015	18:36:00	495.912083	502.885181	498.733878			
3/4/2015	18:36:08	495.912083	502.885181	498.733878			
3/4/2015	18:36:26	495.912083	502.885181	498.733878			
3/4/2015	18:36:16	495.924158	504.405998	498.114283			

POST SYSTEM CAL

Date	Time	Ethylene 191C TE
3/4/2015	18:31:31	12.998153
3/4/2015	18:31:39	62.440062
3/4/2015	18:31:47	8.4462
3/4/2015	18:31:55	97.244863
3/4/2015	18:32:02	98.205489
3/4/2015	18:32:10	98.205489
3/4/2015	18:32:18	98.205489
3/4/2015	18:32:26	101.230587
3/4/2015	18:32:34	101.225392
3/4/2015	18:32:42	102.499200
3/4/2015	18:32:50	102.514999

FTIR QA/QC SUMMARY

SAMPLE RECOVERY CALCULATIONS																
Period	Spike #	Concentration of CO Cylinder	Concentration of Propane Cylinder	Concentration of NO Cylinder	Stack CO2 Concentration	Stack CO Concentration	Stack NO Concentration	Stack Propane Concentration	Stack + Spike CO2 Concentration	Stack + CO Concentration	Stack + NO Concentration	Stack + Propane Concentration	DF Calculated	% Recovery CO	% Recovery NO	% Recovery Propane
PRE TEST	1	499.9	499.1	504.1	6.1	24.7	18.6	24.0	5.5	67.0	60.3	65.9	0.097	92.1%	88.9%	91.4%

ACETALDEHYDE SAMPLE RECOVERY CALCULATIONS

Period	Spike #	Concentration of CH3CHO Cylinder	Stack CO2 Concentration	Stack CH3CHO Concentration	Stack + Spike CO2 Concentration	Stack + CH3CHO Concentration	DF Calculated**	% Recovery CH3CHO
PRE TEST	1	33.1	6.3	0.0	5.7	2.5	0.103	73.7%

PRE SYSTEM CAL

Sensor	System Response (ppm)	Cal Level (ppm)	Cal Recovery (%)
NOx	504.9	504.1	0.2
CO	499.1	499.9	-0.2
Propane	502.3	499.1	0.6
*Ethylene	100.9	102.0	-1.1
Acetaldehyde	34.3	33.1	3.7

PRE DIRECT CAL

Sensor	Analyzer Response (ppm)	Cal Level (ppm)	Zero Response (ppm)	Cal Error (%)	Zero Error (%)
NOx	505.4	504.1	0.4	0.3	0.1
CO	497.4	499.9	-0.1	-0.5	-0.01
Propane	500.4	499.1	0.4	0.3	0.1
Ethylene	100.5	102.0	-0.4	-1.4	-0.4
Acetaldehyde	33.3	33.1	-0.4	0.5	-1.2

POST DIRECT CAL

Sensor	Analyzer Response (ppm)	Cal Level (ppm)	Zero Response (ppm)	Cal Error (%)	Zero Error (%)
NOx	504.4	504.1	0.3	0.1	0.1
CO	496.9	499.9	0.1	-0.6	0.02
Propane	495.1	499.1	0.4	-0.8	0.1
Acetaldehyde	32.4	33.1	0.4	-1.9	1.2

POST SYSTEM CAL

Sensor	System Response (ppm)	Cal Level (ppm)	Cal Recovery (%)
*Ethylene	102.3	102.0	0.2

*CTS Scans are conducted with Ethylene through the sample line.

**Dilution Factor slightly above normal.

CERTIFICATE OF ANALYSIS
Grade of Product: EPA Protocol

Part Number: E05NI99E15A0000 Reference Number: 54-124410001-2
Cylinder Number: CC432824 Cylinder Volume: 144.4 CF
Laboratory: ASG - Chicago - IL Cylinder Pressure: 2015 PSIG
PGVP Number: B12013 Valve Outlet: 660
Gas Code: CH4,CO,NO,PPN,BALN Certification Date: Dec 23, 2013

Expiration Date: Dec 23, 2021

Certification performed in accordance with "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012)" document EPA 600/R-12/531, using the assay procedures listed. Analytical Methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a volume/volume basis unless otherwise noted.

Do Not Use This Cylinder below 100 psig, i.e. 0.7 megapascals.

ANALYTICAL RESULTS					
Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
NOX	500.0 PPM	504.5 PPM	G1	+/- 1.4% NIST Traceable	12/16/2013, 12/23/2013
CARBON MONOXIDE	500.0 PPM	499.9 PPM	G1	+/- 1.0% NIST Traceable	12/16/2013
METHANE	500.0 PPM	509.7 PPM	G1	+/- 0.7% NIST Traceable	12/17/2013
NITRIC OXIDE	500.0 PPM	504.1 PPM	G1	+/- 1.4% NIST Traceable	12/16/2013, 12/23/2013
PROPANE	500.0 PPM	499.1 PPM	G1	+/- 1% NIST Traceable	12/19/2013
NITROGEN	Balance				

CALIBRATION STANDARDS					
Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
CO	12062405	CC157169	487.1 PPM CARBON MONOXIDE/NITROGEN	+/- 0.6%	Jun 22, 2018
CH4	10060909	CC320616	500.5 PPM METHANE/NITROGEN	+/- 0.6%	Aug 07, 2016
NTRM/NO	12061023	CC359411	500.7 PPM NITRIC OXIDE/NITROGEN	+/- 0.5%	Feb 16, 2018
NO2	124206889130	CC323209	4.824 PPM NITROGEN DIOXIDE/NITROGEN	+/- 2.0%	Oct 25, 2015
NTRM	10060514	CC281296	495.3 PPM PROPANE/AIR	+/- 0.5%	Feb 19, 2016

ANALYTICAL EQUIPMENT		
Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
Nexus 470 AEP0000428	FTIR	Nov 21, 2013
Nicolet 6700 AHR0801332	FTIR	Nov 22, 2013
Nexus 470 AEP0000428	FTIR	Dec 21, 2013
Nexus 470 AEP0000428	FTIR	Dec 21, 2013
MKS Multigas 17707558	FTIR	Nov 25, 2013

Triad Data Available Upon Request

Notes:

CERTIFICATE OF ANALYSIS Grade of Product: EPA Protocol

Part Number: E03NI99E15A2059 Reference Number: 54-124356582-2
Cylinder Number: CC259116 Cylinder Volume: 144.4 Cubic Feet
Laboratory: ASG - Chicago - IL Cylinder Pressure: 2015 PSIG
PGVP Number: B12013 Valve Outlet: 660
Gas Code: NO2 Analysis Date: Feb 08, 2013

Expiration Date: Feb 08, 2016

Certification performed in accordance with "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012)" document EPA 600/R-12/531, using the assay procedures listed. Analytical Methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a volume/volume basis unless otherwise noted.

Do Not Use This Cylinder below 100 psig, i.e. 0.7 megapascals.

ANALYTICAL RESULTS				
Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty
NITROGEN DIOXIDE	150.0 PPM	152.6 PPM	G1	+/- 2%
NITROGEN	Balance			
CALIBRATION STANDARDS				
Type	Lot ID	Cylinder No	Concentration	Expiration Date
GMIS/NO2	124320129107	CC411587	195.2 PPM NITROGEN DIOXIDE/NITROGEN	Sep 27, 2015
ANALYTICAL EQUIPMENT				
Instrument/Make/Model	Analytical Principle			Last Multipoint Calibration
O2-1 HORIBA MPA-510 3VUYL9NR	Paramagnetic			Jan 08, 2013

Triad Data Available Upon Request

Notes: OXYGEN 1000PPM

Approved for Release

CERTIFICATE OF ANALYSIS

Grade of Product: PRIMARY STANDARD

Part Number:	X02NI99P15AD524	Reference Number:	48-124465798-5
Cylinder Number:	XC001344B	Cylinder Volume:	144.4 CF
Laboratory:	ASG - Los Angeles - CA	Cylinder Pressure:	2015 PSIG
Analysis Date:	Dec 02, 2014	Valve Outlet:	350
Lot Number:	48-124465798-5		

Primary Standard Gas Mixtures are traceable to N.I.S.T. weights and/or N.I.S.T. Gas Mixture reference materials.

ANALYTICAL RESULTS

Component	Requested Concentration	Actual Concentration (Mole %)	Analytical Uncertainty
ETHYLENE	100.0 PPM	102.0 PPM	+/- 1%
NITROGEN	Balance		



Approved for Release

Airgas Specialty Gases

616 Miller Cut Off Rd

Laporte, TX 77571

281-842-6900

Airgas.com

CERTIFICATE OF ANALYSIS**Grade of Product: CERTIFIED STANDARD-SPEC**

Customer: ROCK SPRINGS, WY
Part Number: X02NI99C15AC0A0
Cylinder Number: CC79089
Laboratory: ASG - LaPorte Mix (SAP) - TX
Analysis Date: Dec 31, 2014
Lot Number: 126-400466822-1

Reference Number: 126-400466822-1
Cylinder Volume: 144.4 Cubic Feet
Cylinder Pressure: 2015 PSIG
Valve Outlet: 350SS

Expiration Date: Dec 31, 2015

Product composition verified by direct comparison to calibration standards traceable to N.I.S.T. weights and/or N.I.S.T. Gas Mixture reference materials.

ANALYTICAL RESULTS

Component	Requested Concentration	Actual Concentration (Mole %)	Analytical Uncertainty
ACETALDEHYDE	30.00 PPM	33.09 PPM	+/- 5%
NITROGEN	Balance		

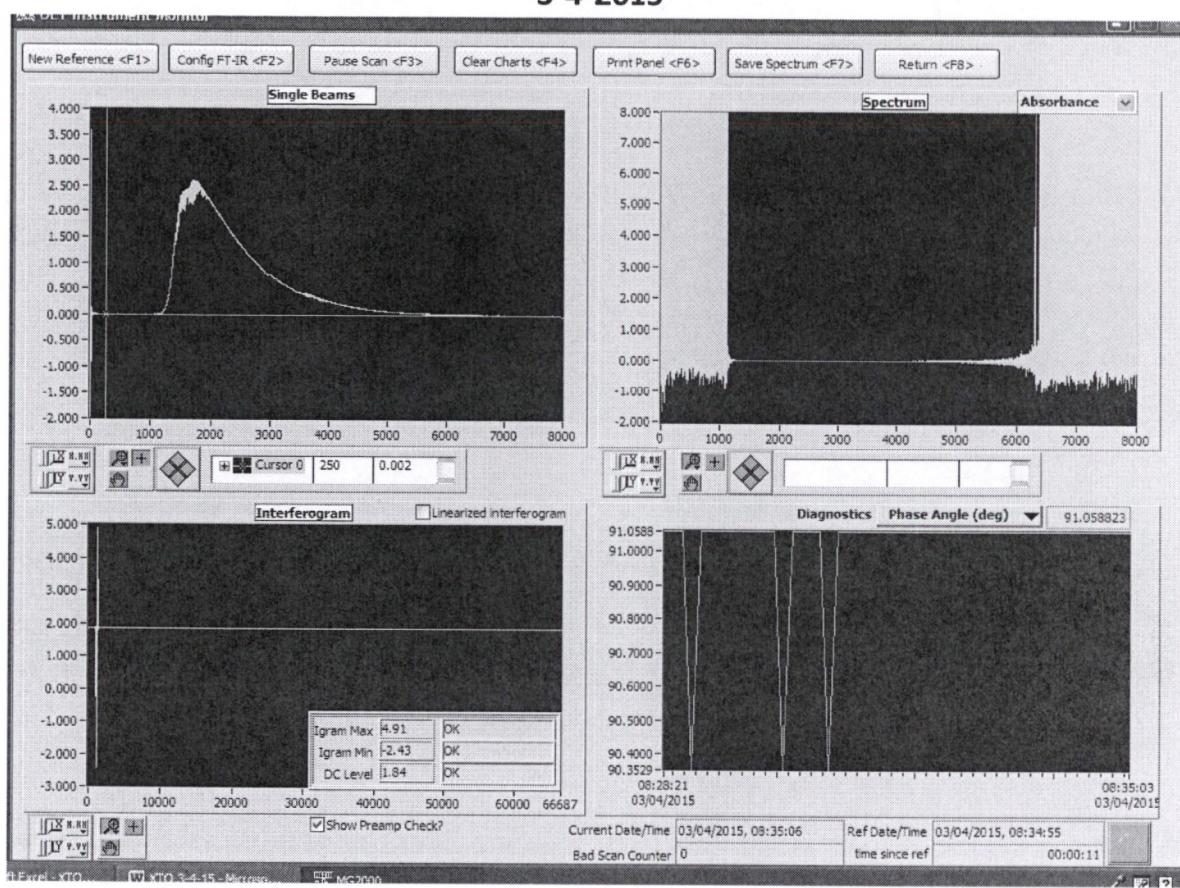
Notes:

ROCK SPRINGS, WY


Approved for Release

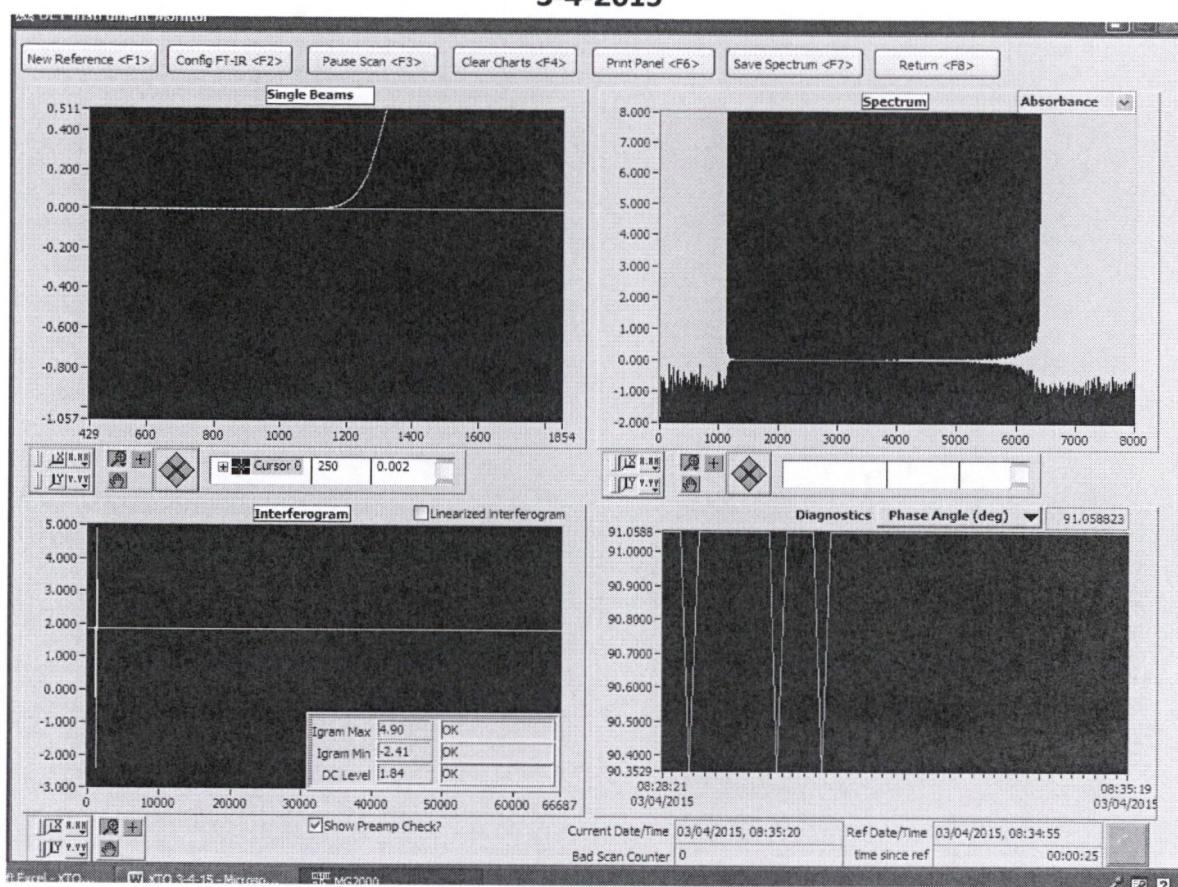
XTO – Little Canyon

3-4-2015

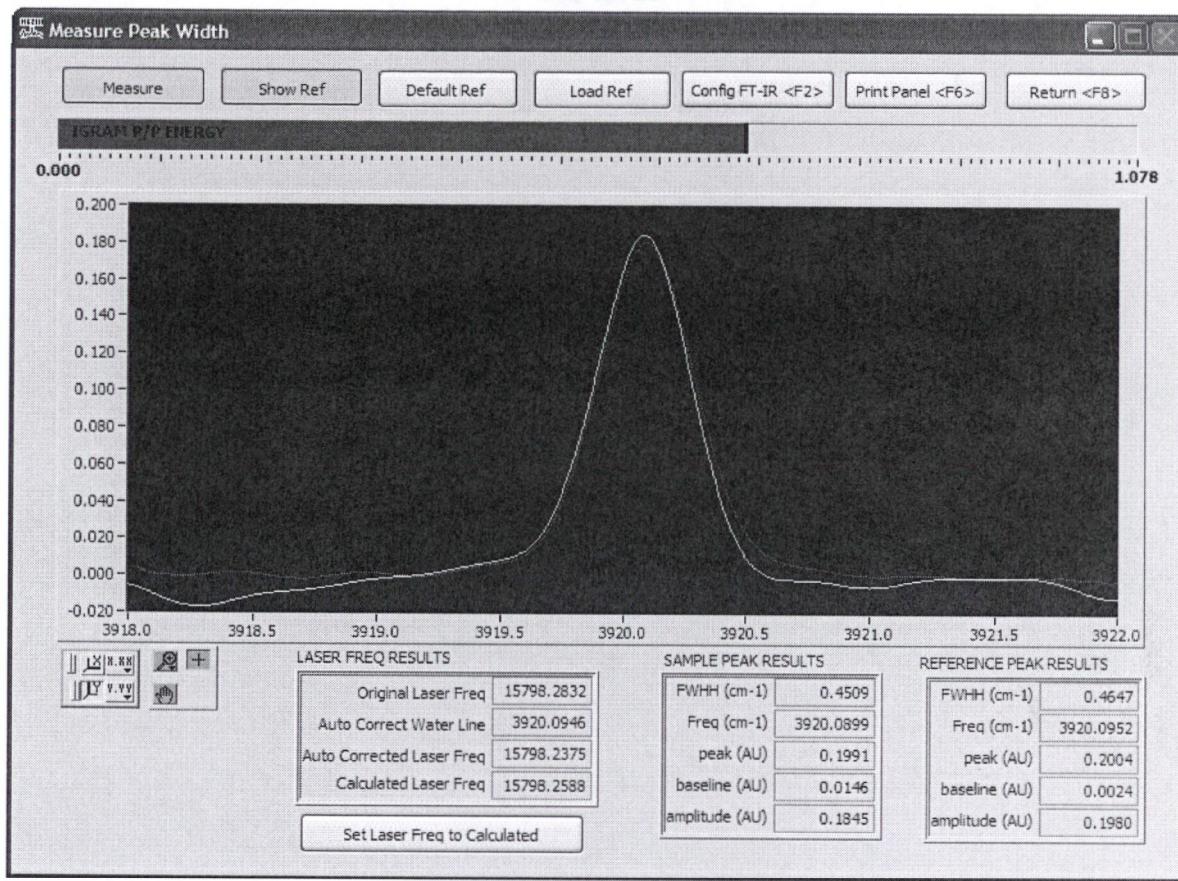


XTO – Little Canyon

3-4-2015



XTO – Little Canyon
3-4-2015



Instrument Resolution – FWHH – 0.4509 cm⁻¹ which is < 0.55 cm⁻¹ (therefore meets ASTM)

Water Frequency – Freq – 3920.0899 cm⁻¹ which is +/- 0.075 of 3920.0952 cm⁻¹ (therefore meets ASTM)

Please note: FWHH is the Full Width at Half Height of the resolution. The frequency position is only calculating the center line for one water line in the spectrum. MKS uses 3920.0952 cm⁻¹ since it is a single water line.

**CO/NO/NO₂/Formaldehyde FTIR Instrument Noise-Limited Minimum Detectable Concentration -
MDC#2**

Noise Equivalent Absorbance Data				
Spectrum	CO	NO	NO ₂	Formaldehyde
XTO LCC-2 3-4-15 000007.LAB	0.14	-0.17	-0.05	-0.24
XTO LCC-2 3-4-15 000008.LAB	0.09	0.00	-0.01	-0.06
XTO LCC-2 3-4-15 000009.LAB	0.07	0.22	-0.14	-0.07
XTO LCC-2 3-4-15 000010.LAB	-0.14	-0.21	-0.12	-0.18
XTO LCC-2 3-4-15 000011.LAB	0.21	-0.42	-0.01	-0.36
XTO LCC-2 3-4-15 000012.LAB	-0.36	0.07	0.02	-0.20
XTO LCC-2 3-4-15 000013.LAB	-0.10	-0.01	-0.02	-0.11
XTO LCC-2 3-4-15 000014.LAB	-0.04	-0.10	-0.01	-0.15
Noise Equivalent Absorbance (Standard Deviation)	0.16	0.17	0.05	0.09
MDC #2	0.49	0.51	0.15	0.26

APPENDIX C

G3516

GAS COMPRESSION APPLICATION

GAS ENGINE SITE SPECIFIC TECHNICAL DATA XTO - LCU #2



ENGINE SPEED (rpm):	1350	RATING STRATEGY:	STANDARD
COMPRESSION RATIO:	8:1	RATING LEVEL:	CONTINUOUS
AFTERCooler TYPE:	SCAC	FUEL SYSTEM:	HPG IMPCO
AFTERCooler WATER INLET (°F):	130		WITH AIR FUEL RATIO CONTROL
JACKET WATER OUTLET (°F):	210		
ASPIRATION:	TA		
COOLING SYSTEM:	JW+OC, AC		Field Gas
CONTROL SYSTEM:	ADEM3		35.0-40.0
EXHAUST MANIFOLD:	ASWC		62.1
COMBUSTION:	LOW EMISSION		1027
NOx EMISSION LEVEL (g/bhp-hr NOx):	2.0		5278
SET POINT TIMING:	27		35

RATING	(WITHOUT FAN)	NOTES	LOAD	MAXIMUM RATING				SITE RATING AT MAXIMUM INLET AIR TEMPERATURE			
				100%	100%	75%	52%	100%	100%	75%	52%
ENGINE POWER		(1)	bhp	1292	1292	969	670				
INLET AIR TEMPERATURE			°F	36	35	35	35				

ENGINE DATA							
FUEL CONSUMPTION (LHV)	(2)	Btu/bhp-hr	7697	7697	7922	8395	
FUEL CONSUMPTION (HHV)	(2)	Btu/bhp-hr	8505	8505	8754	9276	
AIR FLOW (@inlet air temp, 14.7 psia)	(WET)	(3)(4)	ft3/min	2532	2528	1905	1352
AIR FLOW	(WET)	(3)(4)	lb/hr	12163	12163	9165	6503
FUEL FLOW (60°F, 14.7 psia)			scfm	161	161	125	91
INLET MANIFOLD PRESSURE			in Hg(abs)	68.7	68.7	54.1	39.7
EXHAUST TEMPERATURE - ENGINE OUTLET			°F	907	907	906	909
EXHAUST GAS FLOW (@engine outlet temp, 14.5 psia)	(WET)	(7)(4)	ft3/min	7553	7553	5695	4060
EXHAUST GAS MASS FLOW	(WET)	(7)(4)	lb/hr	12642	12642	9535	6774

EMISSIONS DATA - ENGINE OUT							
NOx (as NO2)	(8)(9)	g/bhp-hr	2.00	2.00	2.00	2.00	
CO	(8)(9)	g/bhp-hr	2.25	2.25	2.35	2.50	
THC (mol. wt. of 15.84)	(8)(9)	g/bhp-hr	2.43	2.43	2.53	2.67	
NMHC (mol. wt. of 15.84)	(8)(9)	g/bhp-hr	0.63	0.63	0.66	0.69	
NMNEHC (VOCs) (mol. wt. of 15.84)	(8)(9)(10)	g/bhp-hr	0.42	0.42	0.44	0.47	
HCHO (Formaldehyde)	(8)(9)	g/bhp-hr	0.22	0.22	0.22	0.23	
CO2	(8)(9)	g/bhp-hr	507	507	515	539	
EXHAUST OXYGEN	(8)(11)	% DRY	7.8	7.8	7.8	7.5	

HEAT REJECTION							
HEAT REJ. TO JACKET WATER (JW)	(12)	Btu/min	42326	42326	35191	29246	
HEAT REJ. TO ATMOSPHERE	(12)	Btu/min	5123	5123	4270	3480	
HEAT REJ. TO LUBE OIL (OC)	(12)	Btu/min	6312	6312	5248	4362	
HEAT REJ. TO AFTERCOOLER (AC)	(12)(13)	Btu/min	8645	8645	5469	1987	

COOLING SYSTEM SIZING CRITERIA							
TOTAL JACKET WATER CIRCUIT (JW+OC)	(13)	Btu/min	54134				
TOTAL AFTERCOOLER CIRCUIT (AC)	(13)(14)	Btu/min	9078				

A cooling system safety factor of 0% has been added to the cooling system sizing criteria.

CONDITIONS AND DEFINITIONS

Engine rating obtained and presented in accordance with ISO 3046/1, adjusted for fuel, site altitude and site inlet air temperature. 100% rating at maximum inlet air temperature is the maximum engine capability for the specified fuel at site altitude and maximum site inlet air temperature. Maximum rating is the maximum capability at the specified aftercooler inlet temperature for the specified fuel at site altitude and reduced inlet air temperature. Lowest load point is the lowest continuous duty operating load allowed. No overload permitted at rating shown.

For notes information consult page three.

Run 1 - intake man press -> 21.0 psi -> 42.76 in Hg

$$Patm = 24.64 \text{ in Hg}$$

$$Pabs = 67.40 \text{ in Hg}$$

by linear interpolation, est BHP => 1263.2 BHP

G3516

GAS COMPRESSION APPLICATION

GAS ENGINE SITE SPECIFIC TECHNICAL DATA XTO - LCU #2



ENGINE SPEED (rpm):	1350	RATING STRATEGY:	STANDARD
COMPRESSION RATIO:	8:1	RATING LEVEL:	CONTINUOUS
AFTERCooler TYPE:	SCAC	FUEL SYSTEM:	HPG IMPCO
AFTERCOOLER WATER INLET (*F):	130		WITH AIR FUEL RATIO CONTROL
JACKET WATER OUTLET (*F):	210		
ASPIRATION:	TA		
COOLING SYSTEM:	JW+OC, AC		
CONTROL SYSTEM:	ADEM3		
EXHAUST MANIFOLD:	ASWC		
COMBUSTION:	LOW EMISSION		
NOx EMISSION LEVEL (g/bhp-hr NOx):	2.0		
SET POINT TIMING:	27		

RATING	NOTES	LOAD	100%	100%	75%	52%
ENGINE POWER INLET AIR TEMPERATURE	(WITHOUT FAN)	(1) bhp °F	1292 41	1290 42	968 42	670 42

ENGINE DATA						
FUEL CONSUMPTION (LHV)	(2)	Btu/bhp-hr	7697	7698	7924	8395
FUEL CONSUMPTION (HHV)	(2)	Btu/bhp-hr	8505	8507	8756	9276
AIR FLOW (@inlet air temp, 14.7 psia)	(WET)	(3)(4) ft3/min	2566	2561	1930	1371
AIR FLOW	(WET)	(3)(4) lb/hr	12163	12147	9153	6503
FUEL FLOW (60°F, 14.7 psia)		scfm	161	161	124	91
INLET MANIFOLD PRESSURE		in Hg(abs)	68.7	68.7	54.1	39.7
EXHAUST TEMPERATURE - ENGINE OUTLET		(5) °F	907	907	906	909
EXHAUST GAS FLOW (@engine outlet temp, 14.5 psia)	(WET)	(6) ft3/min	7553	7543	5688	4060
EXHAUST GAS MASS FLOW	(WET)	(7)(4) lb/hr	12642	12626	9523	6774

EMISSIONS DATA - ENGINE OUT						
NOx (as NO2)	(8)(9)	g/bhp-hr	2.00	2.00	2.00	2.00
CO	(8)(9)	g/bhp-hr	2.25	2.25	2.35	2.50
THC (mol. wt. of 15.84)	(8)(9)	g/bhp-hr	2.43	2.43	2.53	2.67
NMHC (mol. wt. of 15.84)	(8)(9)	g/bhp-hr	0.63	0.63	0.66	0.69
NMNEHC (VOCs) (mol. wt. of 15.84)	(8)(9)(10)	g/bhp-hr	0.42	0.42	0.44	0.47
HCHO (Formaldehyde)	(8)(9)	g/bhp-hr	0.22	0.22	0.22	0.23
CO2	(8)(9)	g/bhp-hr	507	507	515	539
EXHAUST OXYGEN	(8)(11)	% DRY	7.8	7.8	7.8	7.5

HEAT REJECTION						
HEAT REJ. TO JACKET WATER (JW)	(12)	Btu/min	42326	42296	35172	29246
HEAT REJ. TO ATMOSPHERE	(12)	Btu/min	5123	5119	4266	3480
HEAT REJ. TO LUBE OIL (OC)	(12)	Btu/min	6312	6308	5246	4362
HEAT REJ. TO AFTERCOOLER (AC)	(12)(13)	Btu/min	8645	8645	5452	1987

COOLING SYSTEM SIZING CRITERIA						
TOTAL JACKET WATER CIRCUIT (JW+OC)	(13)	Btu/min	54134			
TOTAL AFTERCOOLER CIRCUIT (AC)	(13)(14)	Btu/min	9078			

A cooling system safety factor of 0% has been added to the cooling system sizing criteria.

CONDITIONS AND DEFINITIONS

Engine rating obtained and presented in accordance with ISO 3046/1, adjusted for fuel, site altitude and site inlet air temperature. 100% rating at maximum inlet air temperature is the maximum engine capability for the specified fuel at site altitude and maximum site inlet air temperature. Maximum rating is the maximum capability at the specified aftercooler inlet temperature for the specified fuel at site altitude and reduced inlet air temperature. Lowest load point is the lowest continuous duty operating load allowed. No overload permitted at rating shown.

For notes information consult page three.

Run 2 - intake man press -> 21.0 psi -> 42.76 in Hg

$$Patm = 24.62 \text{ in Hg}$$

$$Pabs = 67.38 \text{ in Hg}$$

by linear interpolation, est BHP => 1260.9 BHP

G3516

GAS COMPRESSION APPLICATION

GAS ENGINE SITE SPECIFIC TECHNICAL DATA XTO - LCU #2



ENGINE SPEED (rpm):	1350	RATING STRATEGY:	STANDARD
COMPRESSION RATIO:	8:1	RATING LEVEL:	CONTINUOUS
AFTERCoolER TYPE:	SCAC	FUEL SYSTEM:	HPG IMPCO
AFTERCoolER WATER INLET (*F):	130		WITH AIR FUEL RATIO CONTROL
JACKET WATER OUTLET (*F):	210		
ASPIRATION:	TA		
COOLING SYSTEM:	JW+OC, AC	FUEL:	Field Gas
CONTROL SYSTEM:	ADEM3	FUEL PRESSURE RANGE(psig):	35.0-40.0
EXHAUST MANIFOLD:	ASWC	FUEL METHANE NUMBER:	62.1
COMBUSTION:	LOW EMISSION	FUEL LHV (Btu/scf):	1027
NOx EMISSION LEVEL (g/bhp-hr NOx):	2.0	ALTITUDE(ft):	5278
SET POINT TIMING:	27	MAXIMUM INLET AIR TEMPERATURE(*F):	46
		STANDARD RATED POWER:	1340 bhp@1400rpm

RATING	NOTES	LOAD	100%	100%	75%	52%
ENGINE POWER INLET AIR TEMPERATURE (WITHOUT FAN)	(1)	bhp °F	1292 42	1278 46	959 46	670 46

ENGINE DATA	(2)	Btu/bhp-hr	7697	7707	7938	8395
FUEL CONSUMPTION (LHV)	(2)	Btu/bhp-hr	8505	8516	8771	9276
FUEL CONSUMPTION (HHV)	(2)	ft3/min	2566	2558	1928	1382
AIR FLOW (@inlet air temp, 14.7 psia)	(WET)	lb/hr	12163	12037	9073	6503
AIR FLOW	(WET)	scfm	161	160	123	91
FUEL FLOW (60°F, 14.7 psia)	(3)(4)	in Hg(abs)	68.7	68.1	53.6	39.7
INLET MANIFOLD PRESSURE	(5)	°F	907	907	906	909
EXHAUST TEMPERATURE - ENGINE OUTLET	(6)	ft3/min	7553	7474	5639	4060
EXHAUST GAS FLOW (@engine outlet temp, 14.5 psia)	(WET)	lb/hr	12642	12511	9440	6774
EXHAUST GAS MASS FLOW	(WET)					

EMISSIONS DATA - ENGINE OUT	(8)(9)	g/bhp-hr	2.00	2.00	2.00	2.00
NOx (as NO2)	(8)(9)	g/bhp-hr	2.25	2.25	2.35	2.50
CO	(8)(9)	g/bhp-hr	2.43	2.43	2.53	2.67
THC (mol. wt. of 15.84)	(8)(9)	g/bhp-hr	0.63	0.63	0.66	0.69
NMHC (mol. wt. of 15.84)	(8)(9)	g/bhp-hr	0.42	0.42	0.44	0.47
NMNEHC (VOCs) (mol. wt. of 15.84)	(8)(9)(10)	g/bhp-hr	0.22	0.22	0.22	0.23
HCHO (Formaldehyde)	(8)(9)	g/bhp-hr	507	507	516	539
CO2	(8)(9)	g/bhp-hr				
EXHAUST OXYGEN	(8)(11)	% DRY	7.8	7.8	7.7	7.5

HEAT REJECTION	(12)	Btu/min	42326	42079	35070	29246
HEAT REJ. TO JACKET WATER (JW)	(12)	Btu/min	5123	5087	4243	3480
HEAT REJ. TO ATMOSPHERE	(12)	Btu/min	6312	6275	5230	4362
HEAT REJ. TO LUBE OIL (OC)	(12)(13)	Btu/min	8645	8645	5325	1987
HEAT REJ. TO AFTERCOOLER (AC)						

COOLING SYSTEM SIZING CRITERIA	(13)	Btu/min	54134
TOTAL JACKET WATER CIRCUIT (JW+OC)	(13)(14)	Btu/min	9078
TOTAL AFTERCOOLER CIRCUIT (AC)			

A cooling system safety factor of 0% has been added to the cooling system sizing criteria.

CONDITIONS AND DEFINITIONS

Engine rating obtained and presented in accordance with ISO 3046/1, adjusted for fuel, site altitude and site inlet air temperature. 100% rating at maximum inlet air temperature is the maximum engine capability for the specified fuel at site altitude and maximum site inlet air temperature. Maximum rating is the maximum capability at the specified aftercooler inlet temperature for the specified fuel at site altitude and reduced inlet air temperature. Lowest load point is the lowest continuous duty operating load allowed. No overload permitted at rating shown.

For notes information consult page three.

Run 3 - intake man press -> 21.0 psi -> 42.76 in Hg

$$P_{atm} = 24.62 \text{ in Hg}$$

$$P_{abs} = 67.38 \text{ in Hg}$$

by linear interpolation, est BHP => 1262.2 BHP

APPENDIX D

EPA Method 19 Calculations

Test Run	Fd Factor	BSFC	BHP	Avg O2 %	NOx PPM Corrected	CO PPM Corrected	NOx lbs/hr	CO lbs/hr	NOx g/BHP-hr	CO g/BHP-hr
1	8710	9400	1263.2	9.7	27.7	30.9	0.64	0.43	0.23	0.16
2	8710	9400	1260.9	9.7	33.1	34.5	0.76	0.48	0.27	0.17
3	8710	9400	1262.2	9.7	29.9	32.6	0.69	0.46	0.25	0.16
Average Levels			1262.1	9.7	30.2	32.6	0.69	0.46	0.25	0.16

APPENDIX E

FTIR Engine Test Sheet

Company Name	XTO
Location / Unit I.D.	LLC - 2
Type of Test Completed:	FTIR 3-1 hr Nao, co, HcoH
Field Technician (s)	Stephen Payer
Client Rep and/or State Rep	Derrick - XTO
Date:	3-4-15

	Test 1	Test 2	Test 3
Time of Readings	1:20 pm	2:25 pm	3:35 pm
Atm Pressure (in Hg)	24.44	24.62	24.62
Atm Temp (°F)	35°	42°	46°
Engine RPM	1350	1350	1350
*Manifold Pres. Vac(") or Boost(psi)	21	21	21
Manifold Temp (°F)	128°	129°	131°
Psuction (psi) Stage 1	47	48	48
Tsuction (°F) Stage 1	63°	64°	63°
Pdischarge (psi) Stage 1	120	118	119
Psuction (psi) Stage 2	120	118	119
Tsuction (°F) Stage 2	72°	73°	73°
Pdischarge (psi) Stage 2	430	418	429
Psuction (psi) Stage 3			
Tsuction (°F) Stage 3			
Pdischarge (psi) Stage 3			
Psuction (psi) Stage 4			
Tsuction (°F) Stage 4			
Pdischarge (psi) Stage 4			
Gas Throughput (mmcf/d)			
Pre CO (ppm)			
Pre Cat Temp (°F)	802°	802°	804°
Post Cat Temp (°F)			
Cat Differential Pres. (" of H2O)	4.0"	4.0"	4.0"
Impinger 1 (grams)	/	/	/
Impinger 2 (grams)	/	/	/
Impinger 3 (grams)	/	/	/
Impinger 4 (grams)	/	/	/
Dry Gas Meter (cubic ft)	/	/	/
DGM Inlet Temp (deg F)	/	/	/
DGM Outlet Temp (deg F)	/	/	/
O2 %	9.7%	9.7%	9.7%
CO2 % Dry	6.6%	6.5%	6.5%
LOAD %	95%	95%	95%
Delta H			
Ignition Timing (°F)	25.0°	25.0°	25.0°
AFR Setting mV (Left Bank)			
AFR Setting mV (Right Bank)			
Upstream Port Distance (pd)	48"		
Downstream Port Distance (pd)	48"		
Exhaust Diameter (inches)	12"		Cylinder Serial #↓
Propane	494.1		
NO	504.1		
CO	499.9		
NO2	152.6		
Ethylene	102		
Methane	509.7		
Acetaldehyde	33		
Engine Make	SAT		
Engine Model	3516		
Engine S/N	4EK04246		

* Some units show boost in inches of Hg. In this situation please indicate if it is positive (+) or negative (-). Eg: (+12") or (- 5")

Rev 5

5/25/2011

Worksheet: O2 Stratification

EPA REFERENCE METHOD 3A (Determination Of Stratification)			
Port	Point	Insertion Depth (inches)	Reading (%)
A	1	.3	9.8
A	2	.8	9.7
A	3	1.4	9.8
A	4	2.1	9.7
A	5	3	9.7
A	6	4.3	9.7
A	7	7.7	9.7
A	8	9	9.7
A	9	9.9	9.7
A	10	10.6	9.7
A	11	11.2	9.7
A	12	11.8	9.7
Average			9.7%

Notes: To demonstrate non-stratified flow and utilize one sampling location
 O2 may not deviate by more than +- 0.3%.

- x TO
- LCC - 4
- 3- 4- 15
- 12" stack